BEFORE THE NEBRASKA PUBLIC SERVICE COMMISSION

In the Matter of the Commission, on its own motion, to make adjustments to the universal service fund mechanism established in NUSF-26	Application No. NUSF-50 Progression Order No. 3
In the Matter of the Commission, on its own motion, seeking to investigate whether the zones established in Docket No. 2516 are appropriate in light of NUSF-26 findings and conclusions	Application No. C-3554/PI-112

DIRECT TESTIMONY OF

WILLIAM FITZSIMMONS

ON BEHALF OF

QWEST CORPORATION

APRIL 17, 2007

TABLE OF CONTENTS

1 **I.**   **QUALIFICATIONS AND ORGANIZATION OF TESTIMONY**

2 **Q.**   **PLEASE STATE YOUR NAME AND POSITION.**

3 A.   My name is William Fitzsimmons. I am a Director at LECG, LLC; my business address

4   is 2000 Powell Street, Suite 600, Emeryville, CA 94608.

5 **Q.**   **PLEASE DESCRIBE YOUR PROFESSIONAL QUALIFICATIONS.**

6 A.   I hold a Ph.D. in Resource Economics from the University of Massachusetts, Amherst.

7   My industry experience prior to joining LECG in 1994 includes two years of modeling

8   demand for private line services for AT&T in New Jersey and six years as a financial

9   modeler for BellSouth in Atlanta. At LECG, my work is focused on the economic

10   analysis and financial modeling of telecommunications issues. I have testified numerous

11   times on cost models and economic issues. My curriculum vitae is attached as Exhibit

12   WLF-1.

13 **Q.**   **WHAT IS THE PURPOSE OF YOUR TESTIMONY?**

14 A.   For the portions of this proceeding devoted to setting cost-based prices for unbundled

15   loops in the six proposed zones, the critical question is: Has the Staff set forth credible

16   estimates – on a total element long run incremental cost (TELRIC) basis – of what it

17   would cost to build and maintain loops in each zone? The purpose of my testimony is to

18   explain why the Staff's proposal fails to provide credible TELRIC estimates for any of its

19   proposed zones.

20   The Staff has proposed a methodology for: (1) deaveraging cost-based unbundled

21   network element (UNE) loop prices below the wire center level (with separate in-town

22   and out-of-town prices for each of three existing geographic zones); and (2) revising the

23   cost-based allocation of universal service funding (USF). In his testimony, Mr.

1 Copeland explains that the models used by this Commission to estimate UNE loop costs

2 were not developed to estimate costs below the wire center level, and that it is nearly

3 impossible to modify the models for this purpose. An examination of the Staff's proposal

4 demonstrates that it falls far short of overcoming the modeling limitation described by

5 Mr. Copeland.

6 The foundation of the Staff's proposal is a regression equation that is based on cost

7 estimates from the Benchmark Cost Proxy Model (BCPM). The BCPM itself is a

8 sophisticated and credible TELRIC model. The Staff's methodology, however, strays so

9 far from the BCPM cost estimates that the Staff's proposal cannot claim a credible basis

10 in cost, at least not relative to the standard for cost estimation established since the

11 Telecommunications Act of 1996 (Telecom Act).

12 The Staff's cost estimates and its methodology are described in a paper authored by a

13 Staff member, Tyler Frost, and David Rosenbaum (FR).[1] In this paper, FR appear to

14 suggest that their cost estimates are close approximations of cost estimates from the

15 BCPM. This is false. The FR analysis rests on an attempt to explain the variation in the

16 BCPM loop cost estimates — which result from combining the impacts of many variables

17 — with a single variable, household density, but even a visual inspection of the data

18 reveals that household density is not suited to this purpose.[2] As illustrated in Figure 1,

19 for a representative section of the data used in the FR analysis, substantial amounts of

---

[1] A paper written by Tyler Frost and David Rosenbaum (FR) describes the methodology for creating cost estimates for each of the six zones in the Staff's proposal. *See* Frost, Tyler E., and David I. Rosenbaum, "Recommendations for a Permanent Universal Service Support Mechanism," The National Regulatory Research Institute – Volume 3, December 2005, pp. 31-44.

This paper was attached to the comments of Allo Communications, Mobius Communications, and Pinpoint Communications, presumably in support of their position that "average loop cost is a function of population density." *See* Comments of Allo Communications, et. al., Before the Nebraska Public Service Commission, Application No. C-3554/PI-112, May 3, 2006, p. 4.

[2] The FR equation uses household density as the only explanatory variable in each of the three density groups used in the FR analysis. Dummy variables are used to segregate the data into the three groups.

2

1   variation in the BCPM loop cost estimates are not accounted for by variations in

2   household density.

Figure 1.

Loop Cost Estimates From the BCPM

for a Representative Section of the Data

Used in the FR Analysis
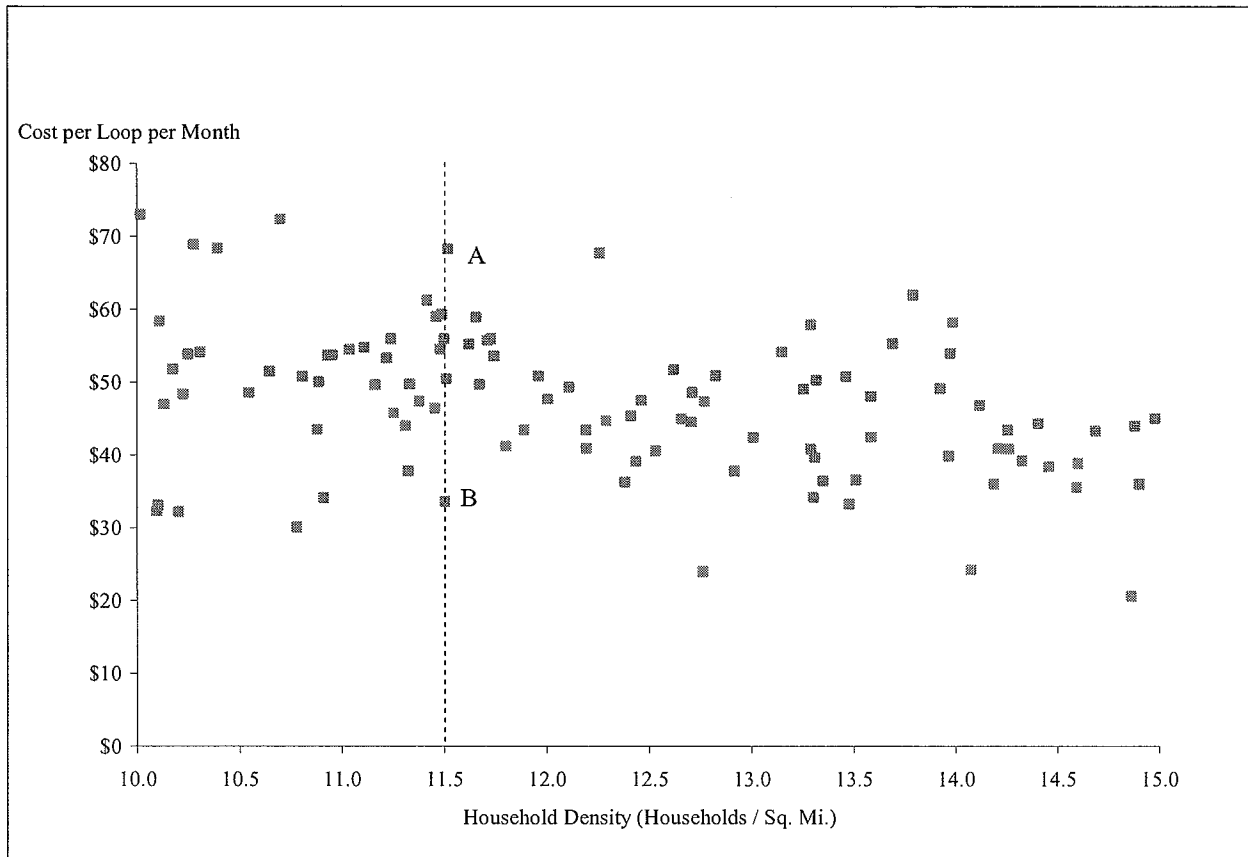
8   The points in this figure represent BCPM cost estimates for areas with household

9   densities of between 10 and 15 households per square mile in Nebraska.[3] As shown,

10   there is a wide dispersion of loop cost estimates for areas with the same household

11   densities. For example, the household densities of areas A and B in the figure are nearly

---

3   The FR equation is based upon loop cost estimates from the BCPM for over 1,200 areas in Nebraska. Because
the household densities from BCPM do not match the household densities in the FR analysis in 5 of these 1,200+
areas, I exclude them from my analysis.

1   identical (11.5 households per square mile), but the loop cost estimates from BCPM are

2   quite different. The loop cost estimate for area A is $68 per loop and the estimate for

3   area B is $34 per loop. This large dispersion of loop cost estimates for areas with the

4   same or similar household densities means that variations in loop cost estimates do not

5   track closely with variations in household densities. As is shown in Figure 1, the wide

6   dispersion of loop cost estimates relative to household density is not restricted to areas A

7   and B, and, as described below, the wide dispersion is not restricted to the section of the

8   data shown in Figure 1.

9   Clearly, a large variation in loop cost estimates for areas with the same or similar

10   household densities makes it impossible to accurately reflect variations in loop cost

11   estimates with this variable alone. The FR equation estimates one loop cost for each

12   household density, and it is mathematically impossible for one loop cost to accurately

13   reflect a cost of $68 and a cost of $34. In fact (as is shown below in Section III), the FR

14   equation estimates a loop cost of $51 for areas with a household density of 11.5, thereby

15   failing to accurately estimate the loop cost estimate in either area.

16   The BCPM and the other accepted cost models use many variables to estimate loop costs,

17   and years of careful considerations of these cost models and their inputs have established

18   a standard for setting cost-based UNE prices and allocating USF. The Staff

19   acknowledges this by basing their proposal on cost estimates from the BCPM, but the

20   Staff discards the richness of detail from the BCPM and estimates costs in a manner that

21   is not consistent with the BCPM (or any of the other detailed models developed for

22   estimating UNE loop costs and allocating USF).

23   The Staff compounds the inaccuracy of its single-explanatory-variable model by applying

24   the results, which are based on household densities in the BCPM, to household densities

25   in census block data. As a result of these and other factors, the Staff proposes cost

1   estimates and USF allocations that are not reasonably related to cost estimates from any

2   credible cost model or combination of models. Any claim to credibility for the Staff's

3   proposed methodology comes from its relationship with BCPM. By the time the cost

4   estimates emerge from the Staff's methodology, however, the results are so far removed

5   from BCPM that the claim to credibility is lost.

6   Given that the Staff's methodology does not even re-estimate BCPM's cost estimates at

7   the wire center level with an acceptable degree of accuracy, the claim that the

8   methodology accurately estimates costs below the wire center level is not believable.

9   With no reasonable cost foundation, the Staff's proposed in-town and out-of-town UNE

10   loop prices are essentially arbitrary, and the Staff's convoluted methodology is an

11   exercise in false precision.

12   **II.   A COST-BASED PROPOSAL REQUIRES REASONABLY ACCURATE COST**

13   **ESTIMATES**

14   **Q.   DOES THE STAFF CLAIM THAT ITS METHODOLOGY IS "BASED ON**

15   **COST"?**

16   A.   Yes, the Staff states that its Unifying Method (UM) establishes six zones, rather than the

17   three established in C-2516, and that "[t]hese zones were established to deaverage

18   unbundled network element (UNE) rates into six geographic areas **based on cost**."[4]

19   Without a standard for assessing what it means to be "based on cost," this term would be

20   open to a wide range of interpretation. A decade of analyzing UNE costs, however, has

---

[4]   Staff Proposal, NUSF-50, Progression Order #3, C-3554/PI-112, Attachment A, February 13, 2007, p. 1
[emphasis added].

5

1   established a standard for cost estimates used to implement the unbundling and USF

2   requirements of the Telecom Act. The Staff's proposal falls far short of this standard.

3   **Q.**   **WOULD YOU PLEASE EXPAND UPON YOUR STATEMENT ABOUT THE**

4   **STANDARD ESTABLISHED FOR ESTIMATING UNE LOOP COSTS?**

5   **A.**   The BCPM estimates TELRICs,[5] as defined by the Federal Communications Commission

6   (FCC) in its First Report and Order in the summer of 1996. The BCPM is one of several

7   detailed and sophisticated cost models that were presented and debated in regulatory

8   proceedings nationwide in the years after the FCC's First Report and Order. The

9   enormous time and effort that regulatory Commissions and private parties expended over

10   the course of several years on the refinement of these models and the values for their key

11   inputs stands as testimony for the importance of accurate cost estimates for the purpose of

12   setting UNE prices and determining USF. The detailed modeling and carefully selected

13   input values that emerged from this process established the standard for estimating the

14   costs of providing loops and local service.

15   **Q.**   **DID YOU PARTICIPATE IN THE EFFORT IN NEBRASKA TO ACCURATELY**

16   **ESTIMATE THE COST-BASIS FOR UNE LOOP PRICES AND UNIVERSAL**

17   **SERVICE FUNDING?**

18   **A.**   Yes. I have testified multiple times on cost modeling issues in Nebraska, including

19   testimony in the 1998 hearing to determine what cost model to recommend to the FCC

20   for estimating universal service support.[6] In the 1998 proceeding I stated that: "Models

---

[5] The cost basis for the Staff's proposal actually includes both TELRIC and the closely related Total Service Long Run Incremental Cost (TSLRIC), which can be viewed as a combination of the TELRICs for the elements comprised by a service.

[6] Direct Testimony of William Fitzsimmons On Behalf of U S West Communications, Inc., Before the Nebraska Public Service Commission, Application No. C-1633, April 8, 1998 (hereafter "*Fitzsimmons 1998*").

1   used for estimating the cost of universal service should be gauged by their abilities to

2   accurately portray the important features and relationships of the Total Service Long Run

3   Incremental Cost (TSLRIC) of providing basic local service in high cost areas."[7] In its

4   Order, the Nebraska Public Service Commission (NPSC) "determined that the BCPM 3.1

5   uncapped model best estimates these costs."[8] When faced with a decision between

6   models, the Commission selected the BCPM 3.1 because "it is more prudent to select a

7   platform that we are confident will ensure a quality network in high cost areas of our

8   state..."[9]

9   The goals described above are as relevant today as they were in 1998, and they are as

10   relevant for selecting a methodology for allocating universal service funding as they are

11   for determining the level of the funding. The Staff's oversimplified regression equation

12   glosses over most of the important features and relationships that drive TSLRIC estimates

13   and makes a mockery of what it means to set cost-based UNE loop prices and make cost-

14   based allocations of USF.

15   **Q.   WHAT OTHER COST MODELS WERE ANALYZED BY THIS COMMISSION?**

16   A.   In 2002, the NPSC analyzed a number of cost models in its efforts to determine cost-

17   based prices for UNEs and establish cost-based geographic zones for UNE loop prices.

18   Specifically, in addition to the BCPM, the NPSC reviewed Qwest's Integrated Cost

19   Model (ICM), AT&T's HAI model, and the FCC's synthesis model (SM).

[7]   *Fitzsimmons 1998*, pp. 4-5.

[8]   Nebraska Public Service Commission, Order in Application No. C-1633, May 22, 1998, p. 3.

[9]   Nebraska Public Service Commission, Order in Application No. C-1633, May 22, 1998, p. 3.

1 Q. **WHAT UNE IS CENTRAL TO THE STAFF'S PROPOSAL, AND HOW DID**

2 **THIS COMMISSION SET THE COST-BASED LOOP PRICE?**

3 A. The UNE loop is central to the Staff's proposal. This is because geographic differences

4 in the costs of basic service are driven by differences in the costs of providing loops. In

5 its 2002 UNE pricing proceeding, the Commission opted to follow its Staff's

6 recommendation to average the loop cost estimates from the BCPM, the HAI model, and

7 the SM. In that proceeding, the NPSC also established geographic zones for cost-based

8 loop prices. As explained by the Commission:

9 "In order to satisfy the FCC's requirement that zone development be cost related,

10 and to remain consistent and focused on the Commission's goal of developing

11 **Loop UNE rates that are both fair and accurate**...the Commission finds zone

12 deaveraging must stand on sound economic principles.

13 Therefore, the Commission finds Loop UNE prices should be deaveraged over

14 three zones...The analysis uses the **average cost per line** of each exchange and

15 arranges similar cost exchanges into zones. The Commission feels this

16 methodology fosters competition and is...based on TELRIC pricing principles."[10]

17 With these findings, the NPSC recognized the importance of accurately estimating cost

18 for the purposes of setting cost-based UNE loop prices and establishing cost-based zones

19 for these prices. This takes on added importance when these prices and zones are also

20 used to allocate universal service funding.

---

[10] Nebraska Public Service Commission, Findings and Conclusions in Application No. C-2516/PI-49, April 23, 2002, ¶¶80-81 [emphasis added].

1 **Q. HOW DID THE STAFF ATTEMPT TO CREATE COST-BASED IN-TOWN AND**

2 **OUT-OF-TOWN UNE LOOP PRICES?**

3 A. Understanding the serious flaws in the Staff's proposal begins with an understanding of

4 the steps that they took to restate the cost-based UNE loop prices for each of the three

5 zones established by the NPSC in 2002 as two separate UNE loop prices, one for in-town

6 and one for out-of-town. A summary of the steps is as follows:

7 1. The process begins with the run of the BCPM 3.1 that was used (along with the HAI

8 and SM) for setting cost-based UNE loop prices.

9 2. Using cost estimates and household densities from BCPM, FR devised a regression

10 equation (FR equation) that estimates loop cost as a function of a single variable,

11 household density (households per square mile).

12 3. Estimated coefficients from the FR equation are applied to household densities in

13 census block data to estimate an average loop cost for each census block.

14 4. Each census block in each of the three deaveraging zones is designated as in-town or

15 out-of-town based upon specific, though unexplained, criteria for density and number

16 of households, and the weighted average loop costs for in-town or out-of-town are

17 calculated based upon the number of households in each census block.

18 As described, the Staff does not offer an independent cost model. It attempts to restate

19 the UNE loop cost estimates from the BCPM, which are designed for aggregation at the

20 wire center level, below the wire center level for in-town and out-of-town areas. The

21 important point is that the BCPM loop cost estimates are the cost basis for the Staff's

22 proposal. As such, the validity of the Staff's cost-based proposal rests critically on its

23 ability to accurately reflect the cost estimates from the BCPM. Otherwise, it is simply a

1   rogue proposal with no credible cost basis, and, in the final analysis, this is an accurate

2   characterization of the Staff's proposal.

3 **Q. DOES IT APPEAR THAT THE STAFF PROPERLY ASSESSED THE ABILITY**

4 **OF THE FR EQUATION TO ACCURATELY REFLECT THE BCPM LOOP**

5 **COST ESTIMATES?**

6 A. No. As shown above and described in greater detail below, the Staff's single-

7   explanatory-variable model does a poor job of capturing variations in the BCPM loop

8   cost estimates, and the Staff could have ascertained this fact with a thoughtful visual

9   inspection of the data or a closer look at the "fit" of its equation to the BCPM loop cost

10   estimates. Since the Staff's methodology begins with loop cost estimates from the

11   BCPM, the methodology should at least be able to recreate the BCPM loop cost estimates

12   with a reasonable degree of accuracy. The fact that the Staff's methodology does not do

13   this should have forced the Staff to rethink its proposal.

14   As described in greater detail in the following section, a review of the FR analysis reveals

15   that: (1) substantial variations in BCPM's loop cost estimates are left unexplained by

16   variations in household density, which is the lone variable in the FR equation; and (2)

17   after applying the results of the FR equation to census block data, the Staff's

18   methodology does not even come close to matching the average loop costs at the wire

19   center level from the BCPM. A methodology that does not even credibly re-estimate

20   loop costs at a wire center level has no credibility in terms of estimating costs below this

21   level.

1   III.   THE FR EQUATION DOES NOT EXPLAIN SUBSTANTIAL VARIATION IN

2   THE BCPM LOOP COST ESTIMATES

3   Q.   DOES THE FR PAPER INCLUDE A POTENTIALLY MISLEADING

4   STATEMENT ABOUT THE FIT OF THEIR REGRESSION MODEL?

5   A.   Yes. The FR paper includes the following potentially misleading statement about the fit

6   of the regression model: "The Equation has an R^2 of 0.95, indicating that 95 percent of

7   the variation in the *natural log* of loop cost can be explained by the variation in

8   density."[11] While true within the methodology discussed in the FR paper, this is

9   misleading to the extent that it infers that the FR equation explains a similar portion of

10   the variation in the *loop cost estimates* from the BCPM. It does not. Variations in loop

11   cost estimates are at issue, not the variations in the natural logs of loop cost estimates.

12   Qwest does not incur the natural log of cost, and CLECs, therefore, do not pay for

13   unbundled loops based upon the natural log of loop cost estimates.

14   Q.   DOES THE FR EQUATION ACCURATELY EXPLAIN THE VARIATION IN

15   THE BCPM LOOP COST ESTIMATES?

16   A.   No. As shown below, when the FR equation is transformed from natural logs back into

17   dollars and compared with the costs estimates from the BCPM, it is apparent that the

18   equation does not explain a large portion of the variation in loop cost estimates from the

19   BCPM. The following charts demonstrate this for the middle density group used in the

20   FR analysis.[12]

---

[11] Frost, Tyler E., and David I. Rosenbaum, "Recommendations for a Permanent Universal Service Support
      Mechanism," The National Regulatory Research Institute – Volume 3, December 2005, pp. 35 [emphasis added].

[12] Although the middle density group was selected for illustrative purposes, the FR equation fails to explain large
      portions of the variations in the BCPM loop cost estimates in all three density zones, as illustrated later in this
      section.

1   Figure 2 shows the loop cost estimates from the BCPM sorted by household density for

2   the middle density group used in the FR analysis, 4.5 to 34 households per square mile.

3   As shown, there is considerable variation in the loop cost estimates across the range of

4   household densities.

5   **Figure 2.**

6   **Cost Estimates From BCPM**

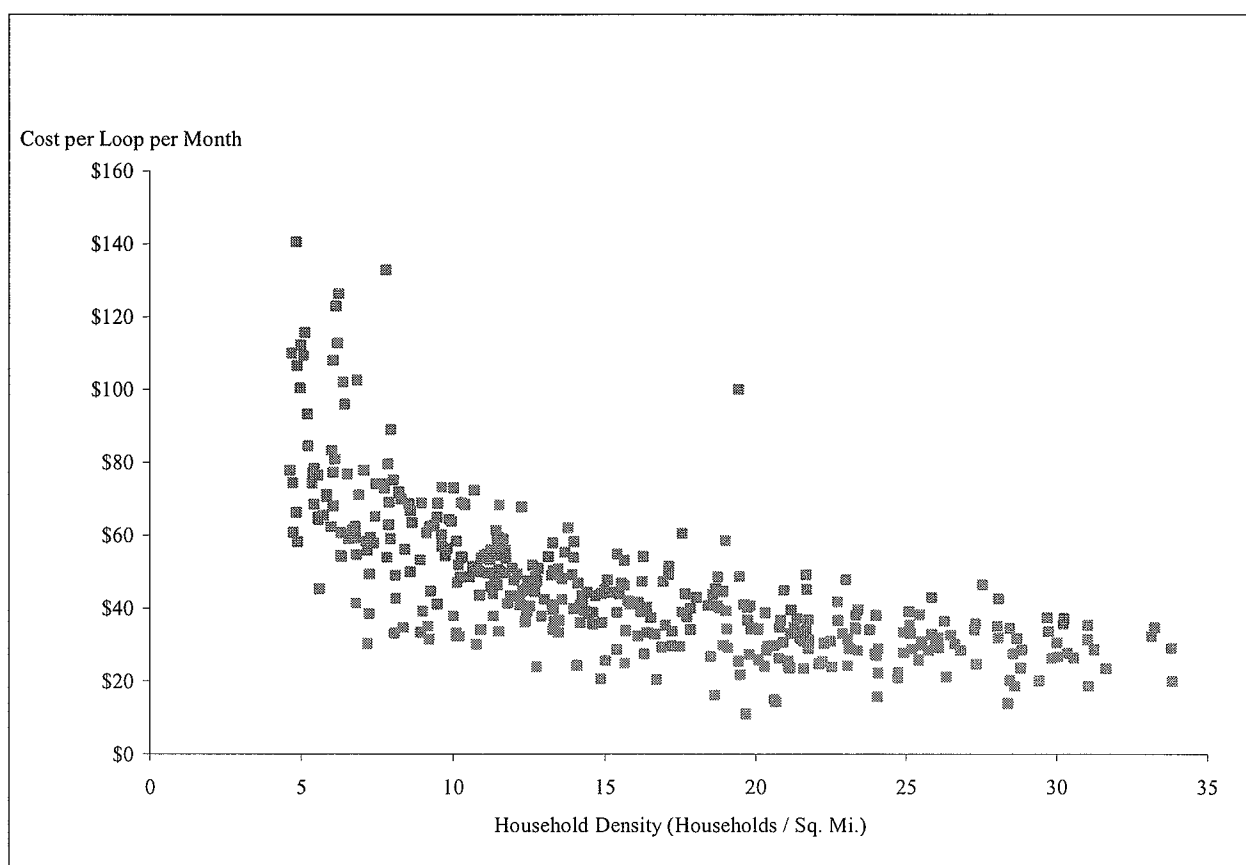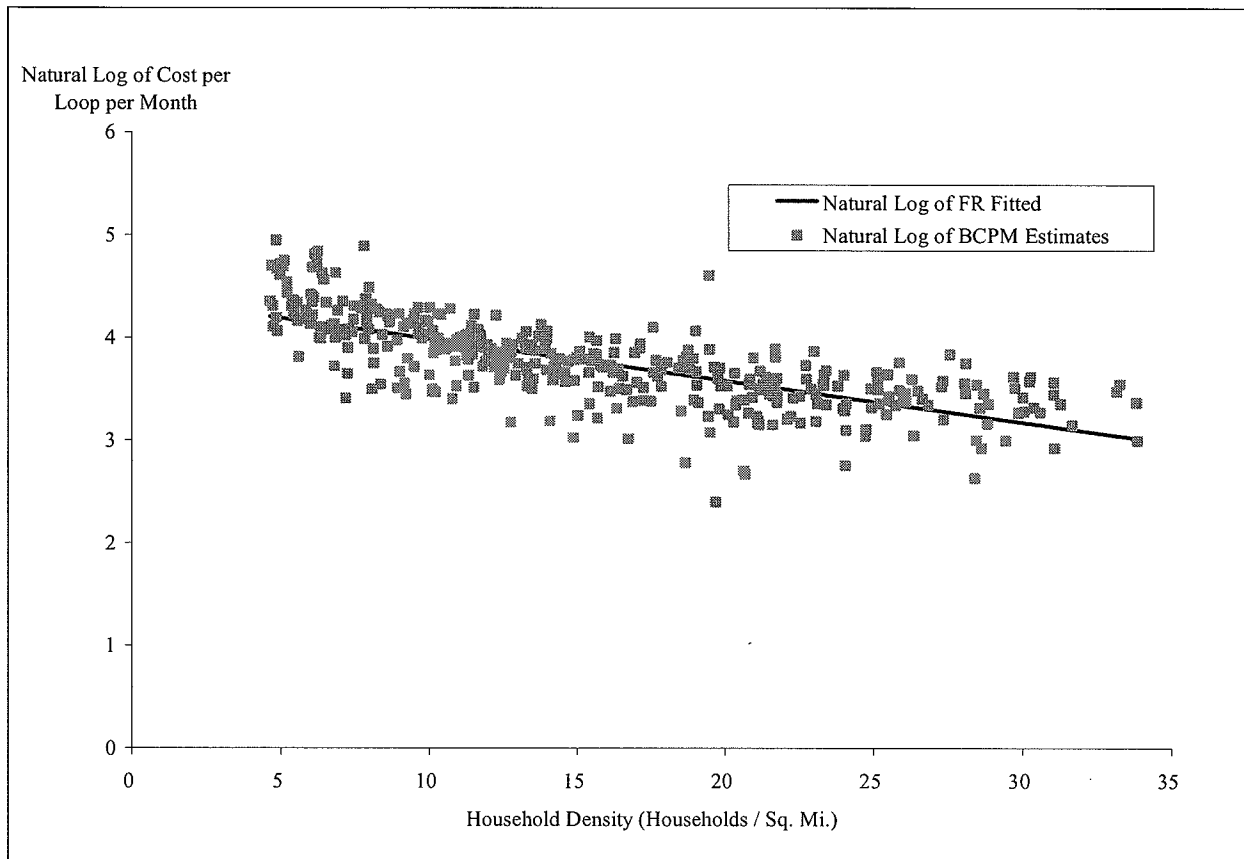7   **For the Middle Density Group in the FR Equation**

8

9   Figure 3 shows the loop cost estimates from BCPM recast as natural logs. The FR fitted

10   line is derived from the FR equation, and it is also shown for this density group on this

11   chart. As shown: (1) taking natural logs compresses the loop cost estimates, thereby

12   giving the appearance of less variation; and (2) the FR equation passes essentially

13   through the center of this compressed data.

1

2 **Figure 3.**

3 **Comparison of the Natural Logs of Cost Estimates**

4 **From BCPM With the FR Fitted Line**

Natural Log of Cost per
Loop per Month

Natural Log of FR Fitted
Natural Log of BCPM Estimates

Household Density (Households / Sq. Mi.)

5

6   A person with a ruler could draw a line that fits the data almost as well as the FR

7 equation shown in Figure 3, and that line would, therefore, explain the vast majority of

8 the variation in the natural logs of loop cost estimates.   It would be incorrect, however, to

9 infer that this equation does a credible job of explaining the variation in the underlying

10 cost estimates.

1   **Q.**   **WHAT HAPPENS TO THE FIT OF THE FR FITTED EQUATION WHEN THE**

2   **RESULTS ARE TRANSFORMED BACK FROM LOG VALUES TO DOLLAR**

3   **VALUES?**

4   A.   Figure 4 shows the fit of the FR equation to the actual dollar values of the loop cost

5   estimates from the BCPM (the same as those shown in Figure 2). As shown, there is a

6   substantial amount of variation in the BCPM cost estimates around the fitted FR

7   equation. This is variation that is not captured in the FR equation.

8   **Figure 4.**

9   **Comparison of Cost Estimates From BCPM**

10   **With the FR Fitted Line**

11
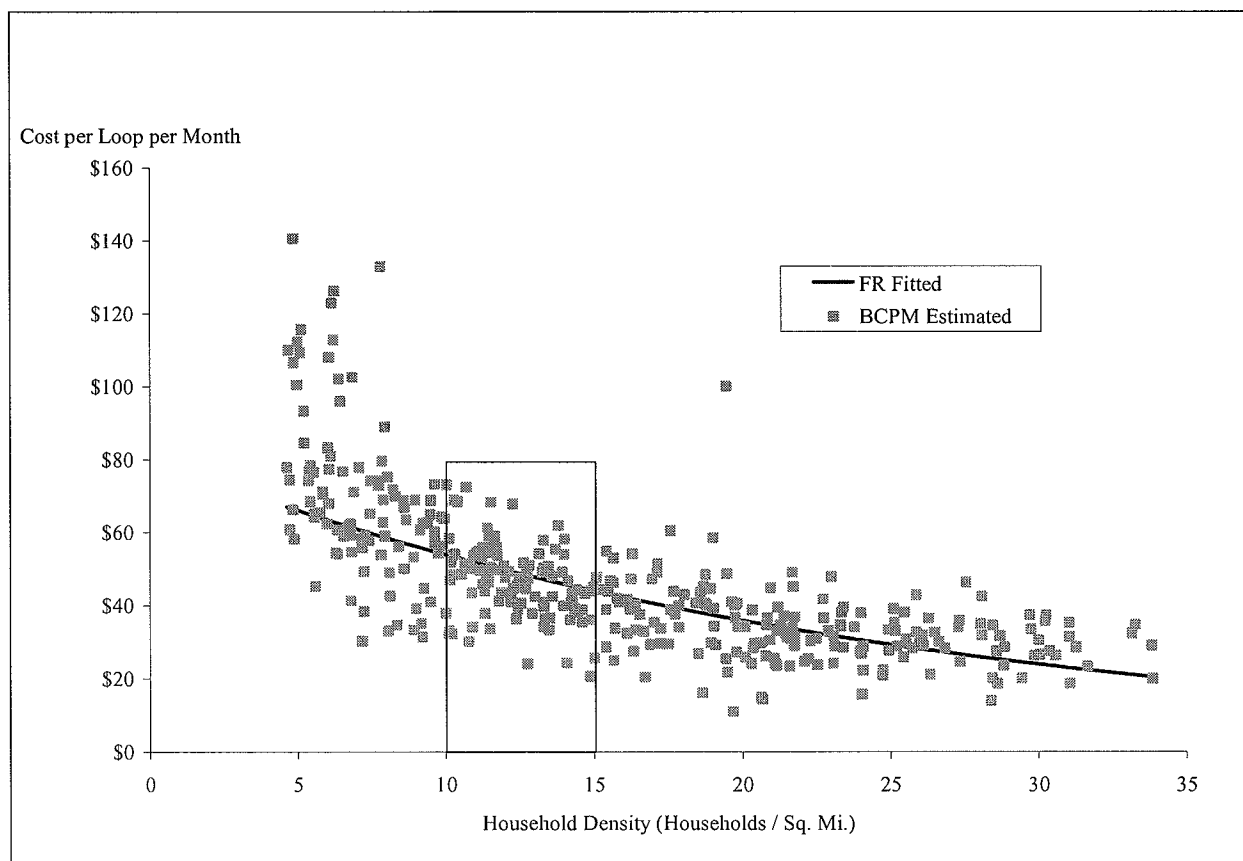
1   **Q.   DOES THE FR EQUATION DO AN ESPECIALLY POOR JOB OF**

2   **EXPLAINING THE VARIATION IN COSTS FOR LOWER DENSITY AREAS?**

3   A.   Yes. The FR equation does an especially poor job of capturing the variation in loop cost

4   estimates in the lower density areas. The FR equation estimates a loop cost of $67 for an

5   area with a density of 4.5 households per square mile and a cost of $54 for an area with a

6   density of 10 households per square mile, a difference of $13. Loop cost estimates from

7   the BCPM, however, range from $141 to $30 across this span of household densities, a

8   difference of $111.

9   **Q.   EVEN IN AREAS WITH SOMEWHAT HIGHER DENSITIES DOES THE FR**

10   **EQUATION FAIL TO EXPLAIN CONSIDERABLE VARIATION IN COST**

11   **ESTIMATES FROM BCPM?**

12   A.   Yes. As shown in the following chart, which is a blow-up of the boxed area in Figure 4,

13   even beyond 10 households per square mile, there is considerable variation in loop cost

14   estimates from BCPM that is unexplained by the FR equation. (The range of household

15   densities shown in Figure 5 is the same range, with the same BCPM loop cost estimates,

16   that was shown in Figure 1.)

1

Figure 5.

2

Expansion of Boxed Area From Figure 4

3
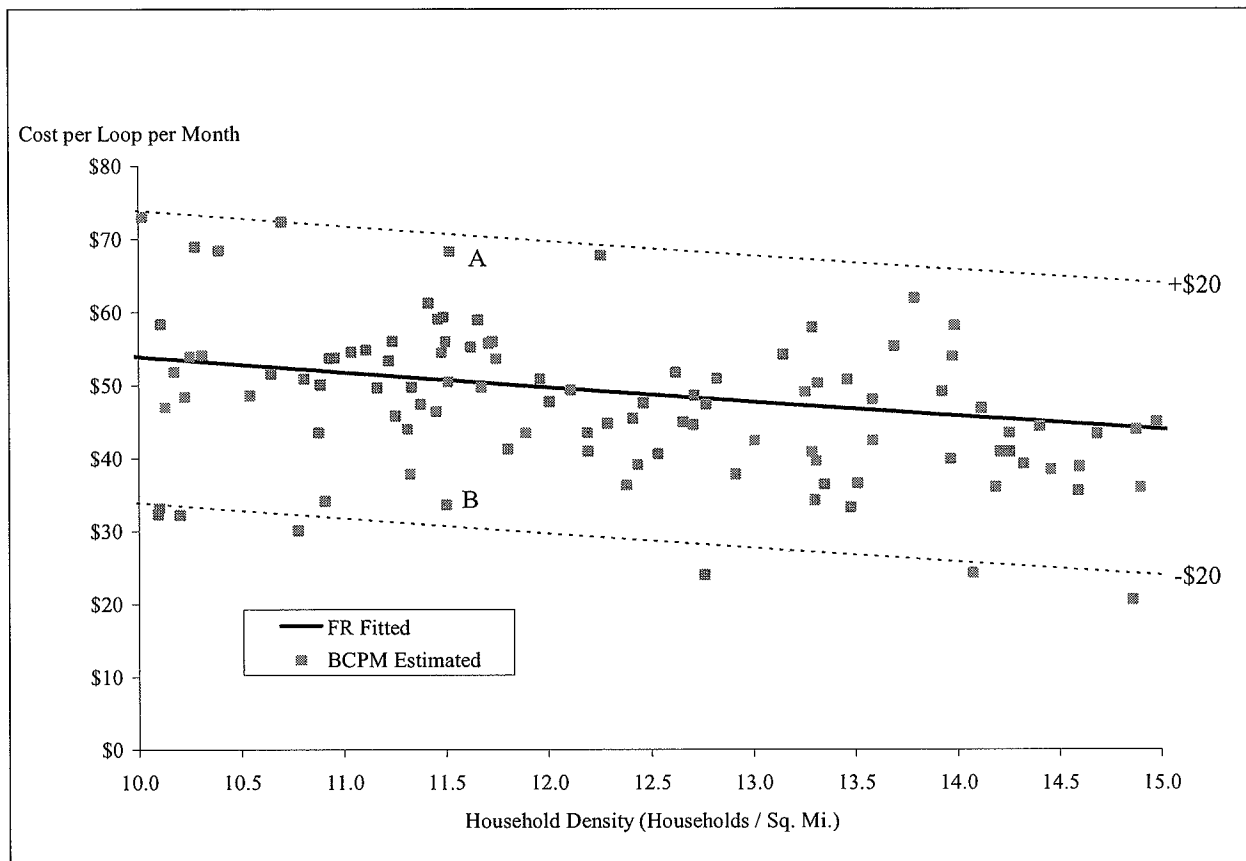
4   Consider the loop costs in areas represented by A and B in Figure 5. As described

5   earlier, in terms of household density these are nearly identical, both with 11.5

6   households per square mile. Yet, the BCPM loop cost estimate for area A is $68 and the

7   loop cost estimate for area B is half that, at $34. The FR equation estimate of $51 for this

8   household density undershoots the BCPM estimate for area A by 25 percent and

9   overshoots the BCPM estimate for area B by 50 percent.
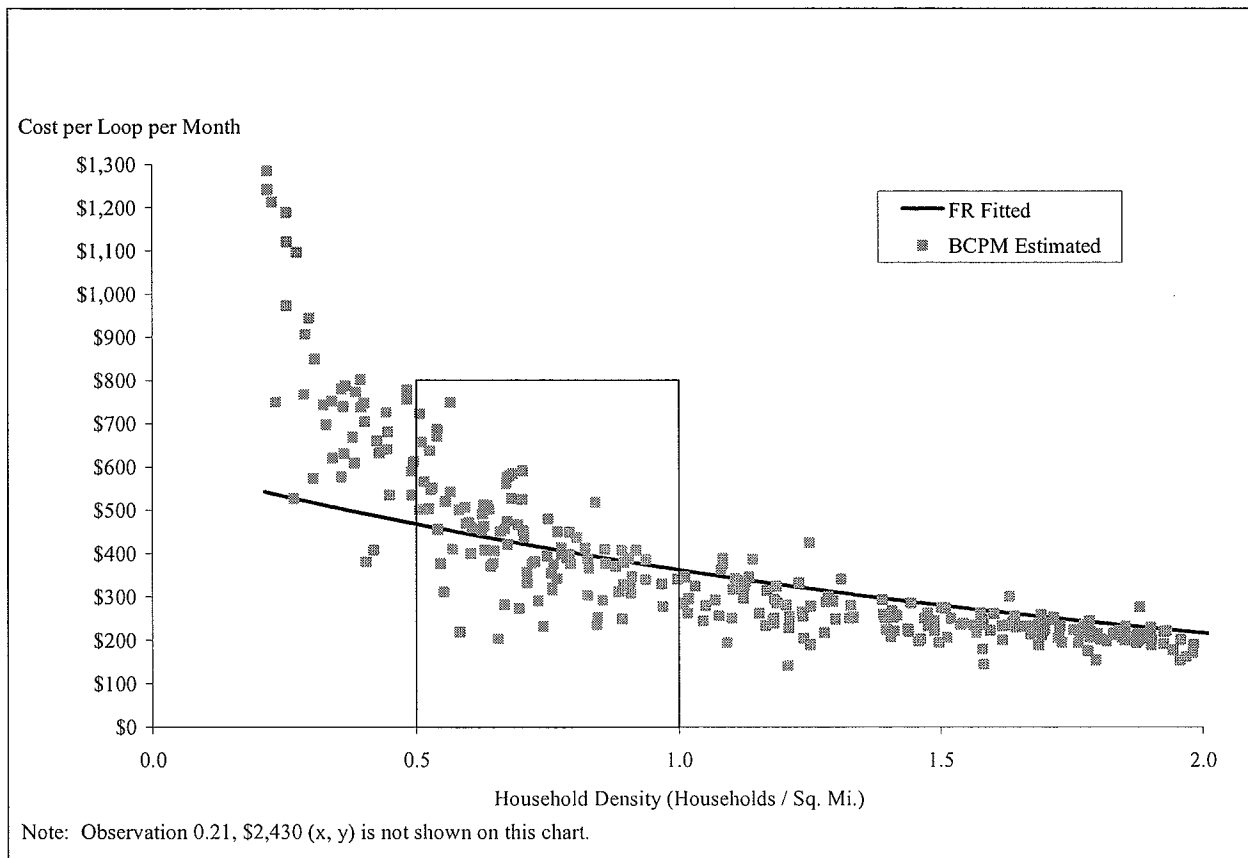
10   The broken lines $20 above and below the FR fitted line provide a sense of perspective

11   on the ability of the FR equation to capture variations in loop cost estimates. Although

12   most of the BCPM loop cost estimates are within plus-or-minus $20 of the FR equation

1   in Figure 5, this range represents a substantial margin of error and can only be described

2   as a poor fit.

3 **Q.** **IS THE POOR FIT OF THE STAFF'S MODEL CONFINED TO THE MIDDLE**

4   **DENSITY GROUP?**

5 A.   No. The poor fit of the Staff's model to the BCPM cost estimates is not confined to the

6   middle density group analyzed above. Figures 6 and 7 show the poor fit of the FR

7   equation for portions of the low density group. As shown in Figure 6, the FR equation

8   does an especially poor job of estimating costs for the very lowest density areas.

9 <div align="center">**Figure 6.**</div>

10 <div align="center">**Comparison of Cost Estimates From BCPM**</div>

11 <div align="center">**With the FR Fitted Line**</div>

12 <div align="center">**0 to 2 Households per Square Mile**</div>

13

Note: Observation 0.21, $2,430 (x, y) is not shown on this chart.

<div align="center">17</div>

1   As shown in Figure 7, which is a blow-up of the boxed area in Figure 6, even where the

2   fit is somewhat better than it is in the lowest density areas, numerous cost estimates from

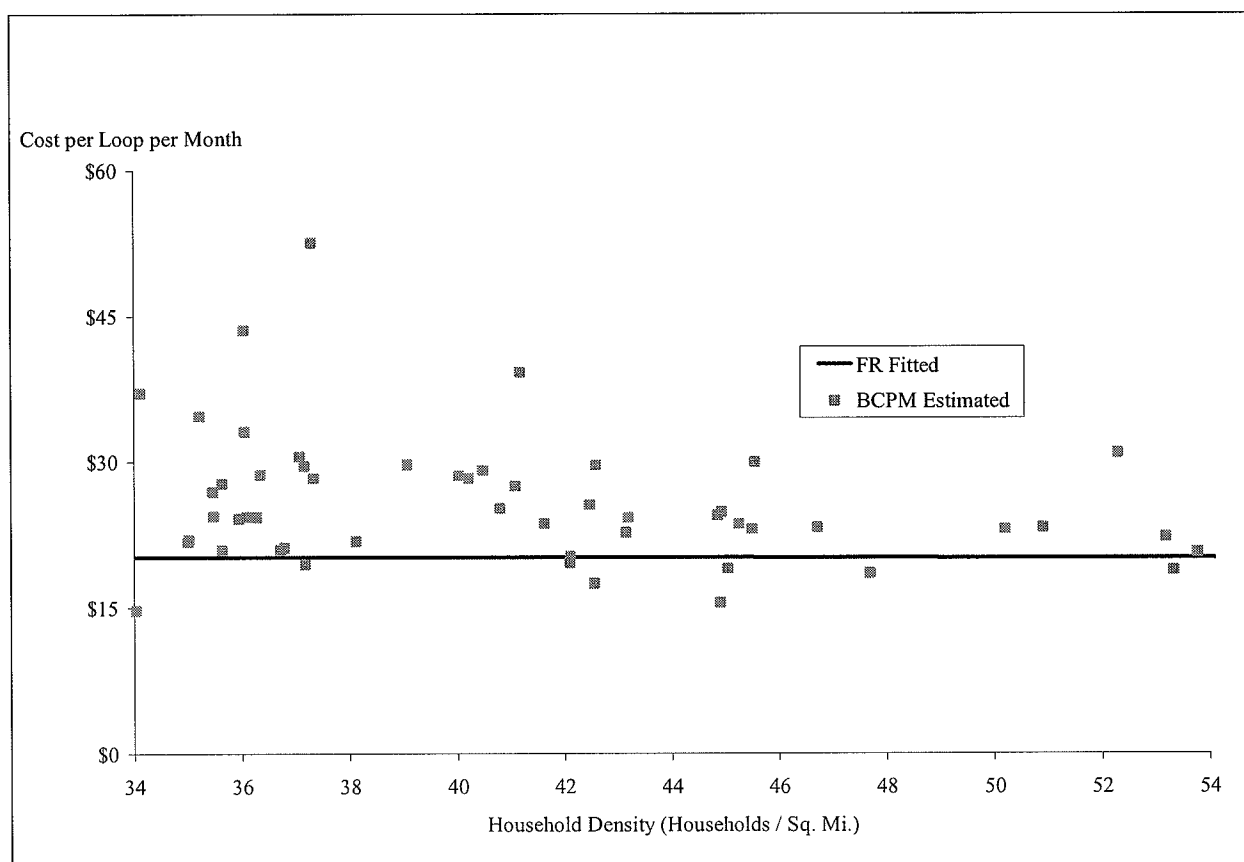3   the FR equation miss the BCPM cost estimates by a substantial amount.

4   **Figure 7.**

5   **Expansion of Boxed Area From Figure 6**

6
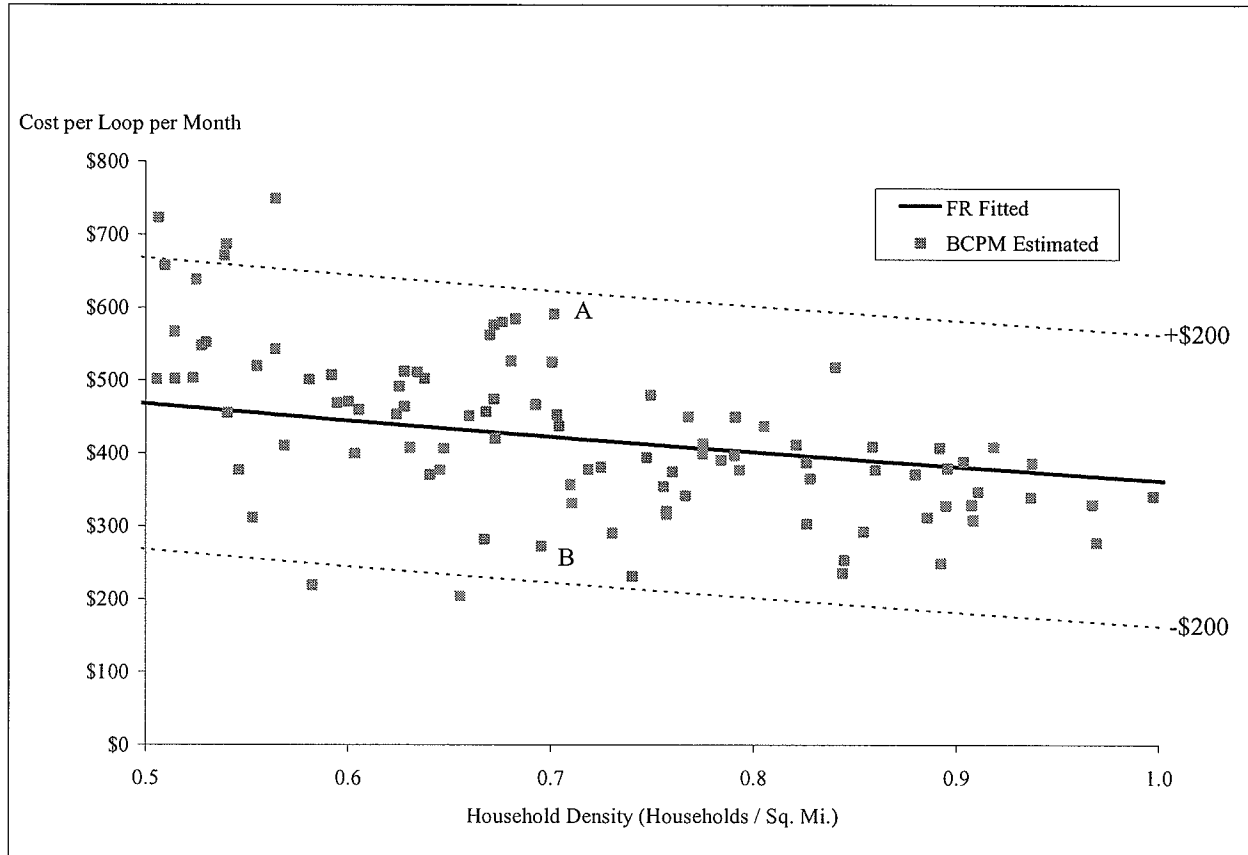
7   Consider, for example, the loop costs in areas represented by A and B in Figure 7. In

8   terms of household density, these are very similar areas, both with 0.7 households per

9   square mile. Using the richness of input information in the BCPM, the loop cost estimate

10   for area A is $591 and the loop cost estimate for area B is less than half that at $273. The

11   FR equation estimate of $423 per loop per month undershoots the estimate for area A by

12   28 percent and overshoots the cost for area B by 55 percent.

18

1   Given that one of the criteria used by FR to assign areas as in-town is a household density

2   of at least 42 households per square mile, it is interesting to look at how well the FR

3   equation estimates costs in this region.   Figure 8 shows the poor fit of the equation across

4   the range from 34 to 54 households per square mile.

Figure 8.

Comparison of Cost Estimates From BCPM

With the FR Fitted Line

34-54 Households per Square Mile

10   As shown, the equation has a strong bias toward underestimating costs in this range. Not

11   only does the FR equation miss the BCPM cost estimates by a wide margin in numerous

12   observations, but for the vast majority of the observations the equation misses on the low

13   side. This non-random direction of errors is indicative of an improperly specified

1   regression equation. In a properly specified equation the errors are more randomly

2   distributed.

3 **III.   THE POOR PERFORMANCE OF THE FR EQUATION IS DUE TO A FLAWED**

4 **DESIGN**

5 **Q.   WOULD YOU PLEASE EXPLAIN WHY THE FR EQUATION DOES A POOR**

6 **JOB OF CAPTURING THE VARIATION IN THE COST ESTIMATES FROM**

7 **THE BCPM MODEL?**

8 A.   The primary reason why the FR equation does not accurately reflect variations in cost

9   estimates from the BCPM is that the FR equation omits key variables that drive

10   differences in the BCPM cost estimates (and differences in real world costs), even in

11   areas with similar household densities.

12 **Q.   HOW DO WE KNOW THAT VARIABLES OTHER THAN HOUSEHOLD**

13 **DENSITY DRIVE THE VARIATIONS IN BCPM'S LOOP COST ESTIMATES?**

14 A.   We know how the BCPM estimates loop costs. We, therefore, know that variations in

15   loop cost estimates in the BCPM, even for areas with similar densities, are driven by

16   variations in numerous variables, including, but not limited to, line density (which can

17   vary significantly from household density), structure sharing, drop lengths, plant mix, and

18   placement costs. The credibility of the FR analysis rests on the assumption that

19   household density does a credible job of representing the combined impacts of the

20   variations in all of these variables. In fact, household density does a poor job of

21   representing the variations in all of these other variables, and, as a result, the FR equation

22   does a poor job of representing the variations in loop cost estimates from the BCPM.

1 . The visual inspection provided above in Figure 1 (and analysis provided throughout my

2 testimony) demonstrates that, while important model inputs vary by density, values for

3 cost inputs vary in such a way that areas with similar household densities can have very

4 different loop costs. It is simply not possible for a single variable, like household density,

5 to capture the richness of detail that exists in the real world, because such richness is

6 reflected by the combinations of variables in sophisticated cost models.

7 Unlike many other state commissions, rather than select a model and focus on the

8 appropriate values for key inputs for estimating loop costs, the NPSC chose to average

9 the results of competing models when it determined unbundled loop prices. Nonetheless,

10 it remains true that the costs estimated across density zones are dependent upon the

11 values of density specific variables, and the manner in which these variables affect loop

12 costs cannot be captured with a single variable, as is proposed by the Staff in this

13 proceeding. As such, the Staff's proposal does not accurately portray the important

14 features and relationships of the TELRIC of providing unbundled loops or basic local

15 service in high cost areas, and it does not stand on sound economic principles.

16 **Q. DOES OMITTING IMPORTANT EXPLANATORY VARIABLES ALSO BIAS**

17 **THE FR ANALYSIS?**

18 A. Yes. Omitting known explanatory variables also means that the coefficients in the FR

19 analysis are biased. Recall that the FR analysis is based upon loop costs estimates from

20 the BCPM computer program, and these loop cost estimates stem directly and completely

21 from the algorithms and inputs in the model. This means that the variables that produced

22 each cost estimate in BCPM are known with certainty. There is none of the uncertainty

23 that exists in the real world about the correct variables, and there are no chance events,

24 measurement errors, or vagaries related to human nature.

1   Ignoring important variables that determine costs in the BCPM (and the real world)

2   creates a biased equation. As explained by Drs. Pindyck and Rubinfeld, when "a variable

3   is unknowingly omitted from the 'true' or correct model specification," the coefficients

4   of the remaining variables are biased, and "[t]his bias will not disappear as the sample

5   size grows large."[13] In the case at hand, the true model specification is the BCPM, and

6   the FR analysis intentionally omits numerous variables from this model.

7   **Q.**   **IS THE USE OF HOUSEHOLD DENSITY, RATHER THAN LINE DENSITY,**

8   **ANOTHER SOURCE OF DISTORTION IN THE STAFF'S ANALYSIS?**
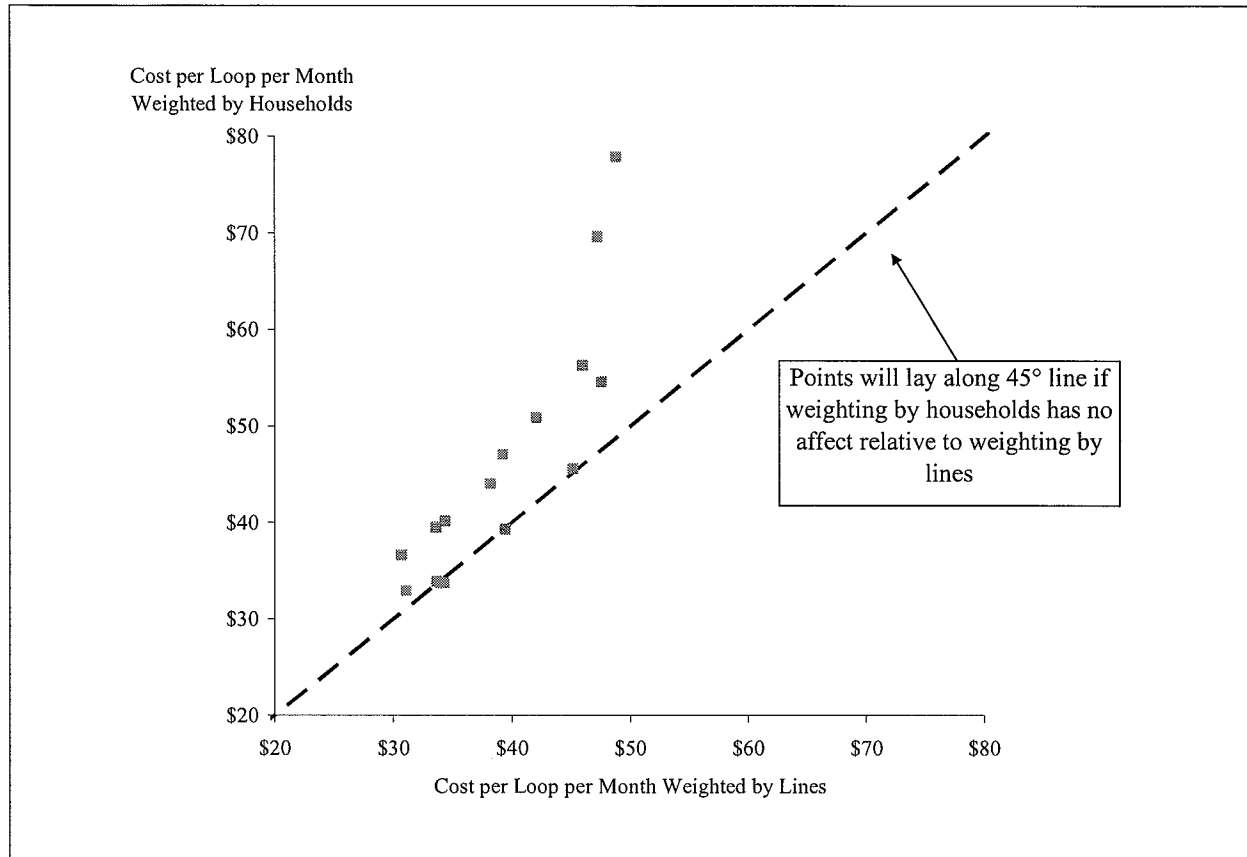
9   **A.**   Yes. The FR equation rests on the flawed assumption that a single explanatory variable

10   can satisfactorily capture the variation in loop cost estimates from a sophisticated cost

11   multi-variable model, such as BCPM. This error is compounded by the selection of

12   household density, which is itself a proxy for line density, as the single variable. In

13   network industries, economies of scale have important cost implications, and it is well

14   understood that economies of scale in telecommunications relate to the number of lines in

15   a geographic area, such as a wire center, and this can be significantly different than the

16   number of households. The importance of economies of scale in telecommunications

17   explains why there was considerable debate over the proper line counts in the cost models

18   used by this Commission, and there was never any doubt that line counts include first

19   lines, additional lines to households, and all business lines.

20   To illustrate the fact that households can vary significantly from lines, Figure 9 shows the

21   impact on the weighted average loop costs from BCPM for each Zone 2 wire center when

22   costs are weighted by households rather than lines.

---

[13] Pindyck, Robert S. and Daniel L. Rubinfeld, Econometric Models & Econometric Forecasts, Second Edition, 1981, pp. 128-129.

1 **Figure 9.**

2 **Comparison of BCPM's Cost Estimates**

3 **for Qwest's Zone 2 Wire Centers**

4 **Weighted by Households v. Weighted by Lines**

Cost per Loop per Month Weighted by Households (y-axis), Cost per Loop per Month Weighted by Lines (x-axis). Callout box: "Points will lay along 45° line if weighting by households has no affect relative to weighting by lines"

5

6 The differences are explained by the fact that, when areas are weighted by households

7 rather than lines, areas with fewer second lines and business lines receive too great a

8 weight. The point of calculating a weighted average is to give more weight to what

9 occurs more often. For example if you spend $5 a day for lunch from Monday to

10 Thursday and $15 on Friday, your weighted average spending for lunch is much closer to

11 $5 than it is to $15, because you spend $5 four days of the work week and $15 only once.

12 In fact your weighted average spending is $7 per day.[14] Bringing the discussion back to

---

[14] (($5 * 4 days) + ($15 * 1 day)) / 5 days = $35 / 5 days = $7 / day.

23

1   cost per loop, if there are two areas, one with 8 lines and 2 households and the other with

2   2 lines and 2 households, the area with four times as many lines should receive four times

3   as much weight when calculating the weighted average cost per loop. Weighting by

4   household, however, would give equal weight to each area. This results in the distortion

5   shown in Figure 9, and it pervades the Staff's analysis.

6   **IV.**   **THE STAFF'S METHODOLOGY STRAYS FAR FROM THE BCPM LOOP**

7   **COST ESTIMATES AT THE WIRE CENTER LEVEL**

8   **Q.**   **HOW ARE THE RESULTS OF THE FR EQUATION APPLIED TO CENSUS**

9   **BLOCK DATA?**

10   A.   After using the FR equation to estimate a relationship between household density and

11   loop cost estimates from the BCPM, the Staff applies the results to census block data. In

12   effect, the Staff multiples the coefficients from the FR equation, which are based upon

13   households per square mile from the BCPM, by households per square mile for each

14   census block. The estimated loop costs for each census block are weighted by

15   households to estimate the weighted average loop costs for each exchange.

16   **Q.**   **OVERALL, DOES THE STAFF'S METHODOLOGY STRAY FAR FROM THE**

17   **BCPM LOOP COST ESTIMATES AT THE WIRE CENTER LEVEL?**

18   A.   Yes. Figure 10 reveals how far the Staff's methodology strays from matching underlying

19   BCPM loop costs upon which it is based. The horizontal line in the chart represents the

20   average loop costs from the BCPM for the 16 wire centers in Zone 2. The points above

21   and below the horizontal line represent average loop costs that result from applying the

22   Staff's FR equation to census data. As shown, the average loop costs from the Staff's

1   methodology miss the BCPM average loop cost for every wire center, and for many wire

2   centers the miss is substantial.

3   **Figure 10.**

4   **"Misses" In Cost Estimates**

5   **Using Staff's Methodology**

6   **For Qwest's Zone 2 Wire Centers**
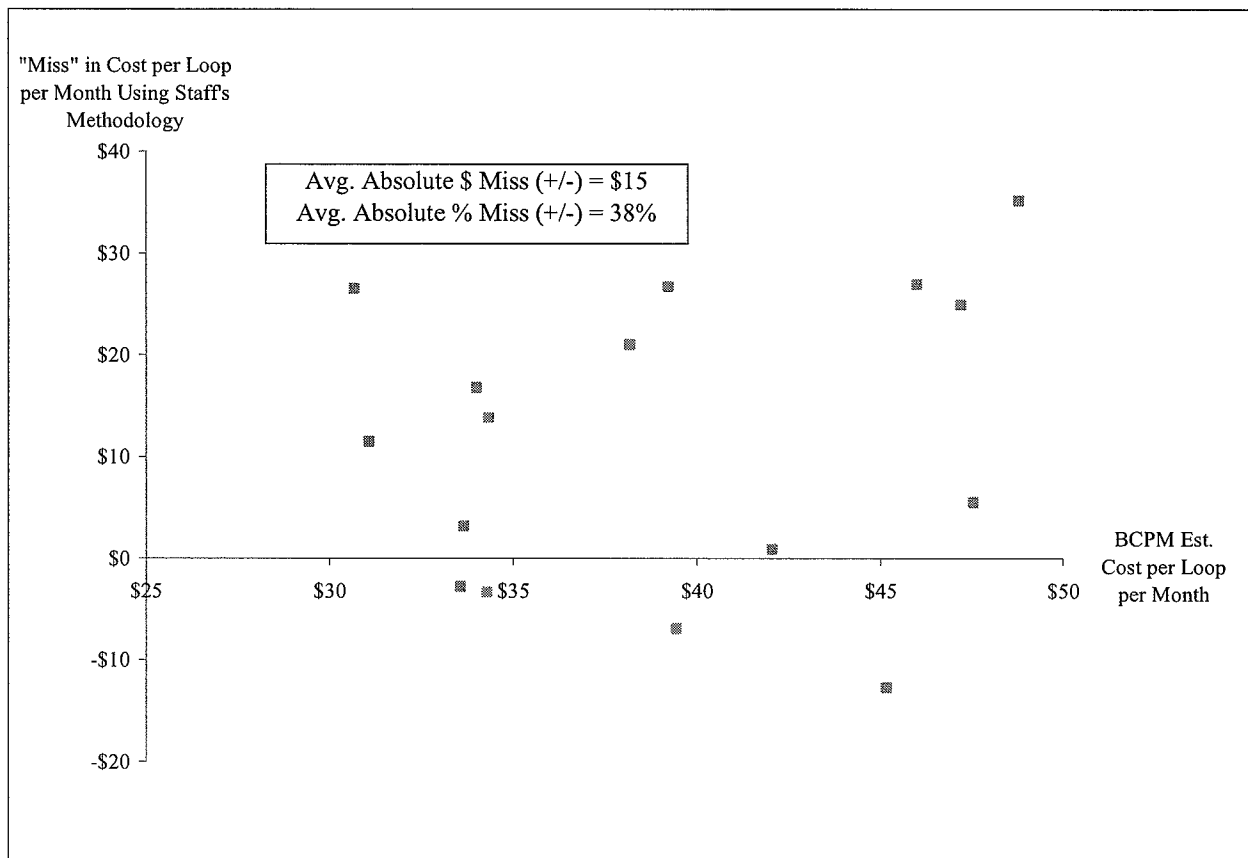
7

8   Overall, the average miss for Zone 2 wire centers, as represented by the average absolute

9   distance from the horizontal line, is $15, or 38 percent. The poor performance of the

10   Staff's methodology is not confined to Zone 2. Across all three zones, the Staff's

1   methodology misses the BCPM's wire center loop cost estimates by an average of 35

2   percent.[15]

3   Recall Mr. Copeland's statement that it is almost impossible to modify the existing cost

4   models to produce credible loop cost estimates below the wire center level. Given the

5   inability of the Staff's methodology to even re-estimate the BCPM loop costs at the wire

6   center level, it defies reason to claim that it can be used to accurately estimate costs

7   *below* the wire center level.

8   Q.   **IN APPLYING THE EQUATION'S COEFFICENTS, DOES THE STAFF SEEM**

9   **TO LOSE TRACK OF WHAT IT ESTIMATED WITH ITS EQUATION?**

10 A.   Yes. In Attachments B and C of the Staff's proposal it appears that the Staff has the

11   mistaken understanding that the FR equation estimates *loop costs per household*. First,

12   loop cost per household is a strange concept, since loops are priced on a per loop and not

13   a per household basis, and second, it appears from the description of the FR equation that

14   it is designed to estimate costs per loop, not loop costs per household.

15   In Attachments B and C of the Staff's proposal, the *HH Weighted Expected Loop Cost* on

16   line 6 is multiplied by the number of households to estimate *Expected Loop Revenue* on

17   line 7. This would make sense if line 6 is loop cost per household. In fact, although the

18   FR equation estimates costs per loop as a function of household density, applying the

19   coefficients from this function results in per loop cost estimates, not per household cost

20   estimates. Following the Staff's misplaced logic, an equation that estimated plant growth

21   (measured in inches) as a function of sunshine (measured in hours per day) would be

---

[15] This does not include the Omaha wire centers. Omaha was omitted because: (1) Qwest is not required to
provide UNE loops at TELRIC-based prices in the nine of the eleven wire centers in Omaha that account for at
least 79 percent of the lines, as reported in BCPM; and (2) the Staff's analysis does not apportion costs to the
individual wire centers in the Omaha Exchange.

1   used to produce estimates of plant growth in hours. This is, of course, nonsensical. The

2   analysis would estimate growth in inches per plant. If there are multiple plants, the total

3   plant growth would be calculated by multiplying the average growth in inches per plant

4   by the number of plants. Likewise, applying the FR equation produces estimates of the

5   average costs per loop in each zone, and the total potential loop cost in each zone should

6   be estimated by multiplying the average cost per loop by the total number of lines in the

7   zone, not by the number of households.

8   **Q.**   **DOES THE STAFF ALSO WEIGHT ITS RESULTS WITH MISMATCHED**

9   **COUNTS OF HOUSEHOLDS AND LINES?**

10   **A.**   Yes, the Staff weights its analysis with mismatched counts of households and lines. As

11   shown in Attachment B of the Staff's proposal, in all six of its proposed zones, the

12   numbers of residential access lines used to calculate the *Proposed UNE Loop Rate* are

13   lower than the numbers of *Households* used to calculate the *Expected Loop Revenue*.

14   For example, for Zone 1 – In-town, there are 269,104 households and 121,489 residential

15   access lines. This is a substantial mismatch. As described above, weighting loop costs

16   by households distorts the cost allocation, because costs are incurred on a per line basis,

17   not on a per household basis. Compounding this distortion with access lines that are

18   clearly mismatched to the household data leaves the Staff with a proposal that is difficult

19   to even characterize.

1   V.   **CONCLUSION**

2   **Q.   DID THE STAFF PROVIDE CREDIBLE TELRIC ESTIMATES FOR THE**

3   **PURPOSE OF PRICING IN-TOWN OR OUT-OF-TOWN UNE LOOPS?**

4   A.   No, the Staff does not provide credible TELRIC estimates for the purpose of pricing in-

5   town or out-of-town UNE loops. The loop cost estimates from the BCPM provide the

6   cost foundation for the Staff's proposal, and the credibility of the proposal rests critically

7   upon maintaining a close link to these cost estimates. The Staff's methodology strays far

8   from the BCPM cost estimates, and in the final analysis is not cost-based relative to the

9   TELRIC standard established since the Telecom Act. This is a serious flaw that leaves

10   the Staff's proposal without a sound cost foundation, and the Staff's proposal should be

11   rejected.

12   **Q.   WOULD YOU PLEASE SUMMARIZE WHY THE STAFF'S METHODOLOGY**

13   **IS INCAPABLE OF ACCURATELY RE-ESTIMATING THE BCPM COST**

14   **ESTIMATES?**

15   A.   The BCPM loop cost estimates are based upon variations in loop lengths, business and

16   residential line counts, sharing percents, placement costs, plant mixes, and a host of other

17   inputs. It would be quite surprising if any single explanatory variable, such as household

18   density, is able to adequately capture the variations among BCPM's cost estimates. As

19   shown above, there are substantial variations in the BCPM loop cost estimates that are

20   not explained by variations in household density. FR devised a model that explains most

21   of the variation in the natural logs of loop cost estimates from BCPM, but it is an

22   oversimplified and biased model that does a poor job of explaining the variations in the

23   loop cost estimates themselves.

1   **Q.**   **WOULD YOU PLEASE SUMMARIZE YOUR ASSESSMENT OF THE STAFF'S**

2   **PROPOSAL?**

3   **A.**   This Commission must determine whether the Staff's proposal provides a reasonable

4   cost-based methodology for deaveraging UNE loop prices below the wire center level

5   and allocating USF. It does not. Given that the Staff's methodology cannot even

6   accurately re-estimate BCPM's cost estimates at the wire center level for which the

7   BCPM was designed, it is not reasonable to conclude that the Staff's methodology can

8   accurately deaverage loop costs below the wire center level.

9   **Q.**   **DOES THIS CONCLUDE YOUR TESTIMONY?**

10   **A.**   Yes it does.